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ABSTRACT

Brain research has illuminated several areas of the learning process: (1) learning as association; (2) learning as reinforcement; (3) learning as perception; (4) learning as imitation; (5) learning as organization; (6) learning as individual style; and (7) learning as brain activity. The classic conditioning model developed by Pavlov advanced knowledge of learning by association. Research into learning as reinforcement is focused on the response of the individual to repeated similar situations. Problem solving capabilities and perception of environment are factors in perceptual research. Research into imitation and organization as learning tools has resulted in increased knowledge of accepted behavior and "cognitive maps." Individualized learning style has been the focus of much classroom research and has resulted in having an impact on practices related to learning structure and materials. Recent research into brain growth and brain activity has produced numerous findings. Implications for education are developing from research into memory, physiological development, and hemispheric dominance. (FG)

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BRAIN RESEARCH:

IMPLICATIONS

FOR

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Brain Research: Implications for Learning

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Learning is viewed as a varied process of association, reinforcement, perception, imitation, organization, cognitive styles, and brain activity. The brain detects patterns in the environment and so needs a variety of input in order to match new information against similar information already stored in the brain. Since the brain operates by programs of function, the process of building and storing hundreds of programs creates a distinctive repertoire in each individual brain.

The research into hemispheric functioning has yielded information leading to an interpretation of the specialization of the two brain halves. The left side appears to be more efficient in processing information which is verbal, logical, or analytical; the right side, the stronghold of art, music, and spatial activity. Other work indicates sudded spurts in brain development, suggesting alterations between rapid brain growth periods and plateau periods when little brain growth is noted. During rapid growth times, new knowledge is more quickly assimilated. When brain development is slower, the acquisition of new knowledge is diminished. The evidence so far obtained shows that left-brain functions may be stimulated in periods of rapid growth, and right-brain functions may be enhanced during the calmer periods of brain development.

Implications of these findings suggest very different applications in typical learning environments.

Brain Research: Implications for Learning

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Although we have hardly scratched the surface in acquiring knowledge about the mind, recent brain research hints at a possible breakthrough in information about how we learn. What have we discovered so far?

1. Learning as Association

This is the classical conditioning model attributed to Pavlov and his dogs. It consists of pairing a stimulus (like food) which produces a particular response (like salivation) with another stimulus (like footsteps) which would ordinarily be neutral in the situation. In school, a first-grade class may be learning to recognize the word "HOUSE." By pairing a picture of a house with the letters, an association can then be made with the response of saying, "house." Soon afterward, the children can be expected to say the word "house" (or "read" it) to the specific combination of letters without also seeing the picture of a house.

2. Learning as Reinforcement

In this model of the learning process, attention is focused on the response of the individual. Receiving a "reward" serves to strengthen the response so that the individual is likely to repeat it. For example, a child floats a paper air-

plane out the open window of a classroom. If the classmates laugh, the child may see this as a satisfying effect and so may do it again--perhaps even more readily--when the opportunity arrives. E. L. Thorndike and his cats started this tradition with his "Law of Effect," which as clarified and expanded by B. F. Skinner. It is also rewarding to get out of an unpleasant situation, such as avoiding a bully by going home a different route.

3. Learning as Perception

Gestalt psychology is concerned with experience as a whole and with the ways we look at our environment. A child who sees her own story in print for the very first time perceives the task of reading in a much different way than she did before. Learning in this way is also a problem-solving approach in that we come upon a solution by bringing parts together (or ideas) in a new arrangement--a flash of understanding. If one is instructed to connect the dots below (a) with only four straight lines and without lifting a pencil, one would be hard-pressed to do so unless one gets out of the space outlined by the arrangement of the dots and creates a new pattern (b).

(a)

(b)

4. Learning as Imitation

We pick up a great deal of information from observing others. A baseball coach demonstrates how to stand at home plate. A singing idol's hair-do is copied by young fans. On the other hand, a child who is scolded for shouting out the answer to a teacher's question without waiting to be called upon has a tendency to inhibit other children from doing the same thing. Punished behavior is less likely to be imitated by observers than would be rewarded actions. We also tend to imitate the behavior of those who have control of rewards or who have power over our behavior, such as teachers and parents.

5. Learning as Organization

Tolman discovered that we always have purposes or goals which give focus to our activities and learning experiences. We develop "cognitive maps" or blueprints for operating to achieve our objectives. One of his classic experiments arranged for a chimpanzee to watch the caretaker place a banana under a bowl outside the room where the chimp was standing. When the chimp was not watching, a lettuce leaf was substituted for the banana. Hours later, the chimp was released, and acted quite angrily because it had expected to find the banana. So the chimp continued to look under everything in sight in order to come upon the choicer food.

6. Learning as Individual Style

People apparently learn in different ways according to individual styles and their own needs. The environment has a

differential effect upon us in terms of our predispositions and internal structures. For example, some students tolerate a higher noise level; others need almost complete silence when working in school, at home, or at the office. Some like the classroom warmer than do others. Some prefer a great deal more light.

The amount of structure in the learning situation is another factor. Some students require more direction and guidance. Others do not want to be "fenced in" or given too much organization; they prefer to create their own. Adults on the job indicate similar differences.

Some people enjoy learning or working in groups; others perfer to work alone. We know about "night people" and "day people." So, some people perform best early in the morning. Others cannot get started until after lunch. Some children are constantly moving and cannot stay seated at their desks; others are able to stay put for a fairly long time.

People are different in the sensory equipment through data from the environment flow. This means that about 30% appear to be "auditory"--they seem to learn and remember best what they hear (Dunn & Dunn, 1978). About 40% are primarily visual learners. The others are combinations of movement and touch with the visual focus.

Variations in learning style noted above can be combined with the variety of teaching styles. In a "task-oriented" situation, the teacher may prescribe what performance is required and what materials should be used. Some teachers prefer

an emotionally charged situation where students are treated to unexpected events and exciting material. Some children wear thin quickly when they remain in such a charged environment over a period of time. Others thrive on it.

7. Learning as Brain Activity

The brain is an amazing organ. Even though it is slower than a computer, it can operate along many thousands of channels all at the same time. It never rests; it continually picks up messages from outside and sends them to various receiving centers for analyzing and interpreting. The brain detects patterns in the environment and so needs a wide variety of input so that it can match new information against similar information which has already been stored in the brain (Hart, 1975). At a very young age, children can recognize a "dog," whether it be a pekingese or a German shepherd. The teacher's role here is to expose the student to many different materials, methods, and activities to stimulate the brain and encourage it to create programs for future use.

The brain operates by programs of function (Young, 1978). In order to do a division problem, the child must first construct in the brain a specific program for each activity in the division process. After building and storing hundreds of programs, we then select the appropriate one for the occasion and let it "play" like a tape recorder. We know which program to play, at least most of the time, because we recognize the pattern. Of course, we cannot assume that all

students in the same classroom have created the same programs in their heads any more than we can expect people to have the same fingerprints. Each brain's repertoire of programs is distinctive, having been developed by the learner's own efforts. The process of remembering, therefore, is a problem of retrieving the information stored (Tulving & Thompson, 1980).

The young brain has been found to vary in physiological development so that sudden bursts of chemical energy or sustained changes in brain growth take place at some ages and not others--the first year of life, then between ages two and four, six to eight, ten to twelve, and fourteen to sixteen (Epstein, 1978). The times inbetween are periods of lessened activity or plateaus. During rapid growth times, new knowledge is more quickly assimilated. When brain development slows down, the acquisition of new knowledge is also lessened.

The research into the functions of the two brain halves provides some information about the possible "specialization" of the two hemispheres. The left side of the brain appears to be more efficient in processing information which is verbal, logical, or analytical (Springer & Deutsch. 1981). The right side seems to be the stronghold of art, music, and spatial activity (Figure 1).

The combination of spurts in brain growth and hemispheric activity suggests that left-brain functions may very well ve stimulated by a brain which is experiencing rapid growth. Right-brain functions may be enhanced during the calmer periods of plateaus in brain development. It might mean that the 12-

to 14-year-old students, who are experiencing slower brain activity, might very well profit more from a couple days each week outside the school environment and into work settings or helping the community than remaining in the typically and often intensely academic environment of the junior high school every school day of every school week.

Because brain growth and brain activity are measurably lessened within this time frame, attempts to inject novel intellectual competencies and in-depth study might very well be counterproductive. As Epstein (1978) concludes, "Children exposed to intellectual pressures and inputs for which they have not proper circuitry may learn to rejct such inputs; such a rejection might even result in an inability to take in such inputs later when the circuitry has developed."

More exposure to spatial activity and the arts might also be indicated for the junicr high school or middle school student, as well as more consistency of interpersonal relationships. For example, eleven-year-olds or sixth-graders might be more productive in a self-contained classroom where the classmates are the same, for the most part, as they have been during the previous years, and the learning experiences are primarily the responsibility of one central instructor.

There has been extraordinary progress in the understanding of the mechanisms of the mind and brain, especially as they illuminate the process of learning. But, as Robert Frost insisted, "We have miles to go before we sleep." In the meantime, let us re-examine our theories of learning and

subsequent educational practices to take into consideration the findings from study into the frontiers of neuroscience. The technological leaps which are expected by the 21st century would seem to indicate that, as we develop more precise and effective measuring devices which can seek out the secrets of the brain and mind, we may discover that radical changes in educational services are necessary for survival.

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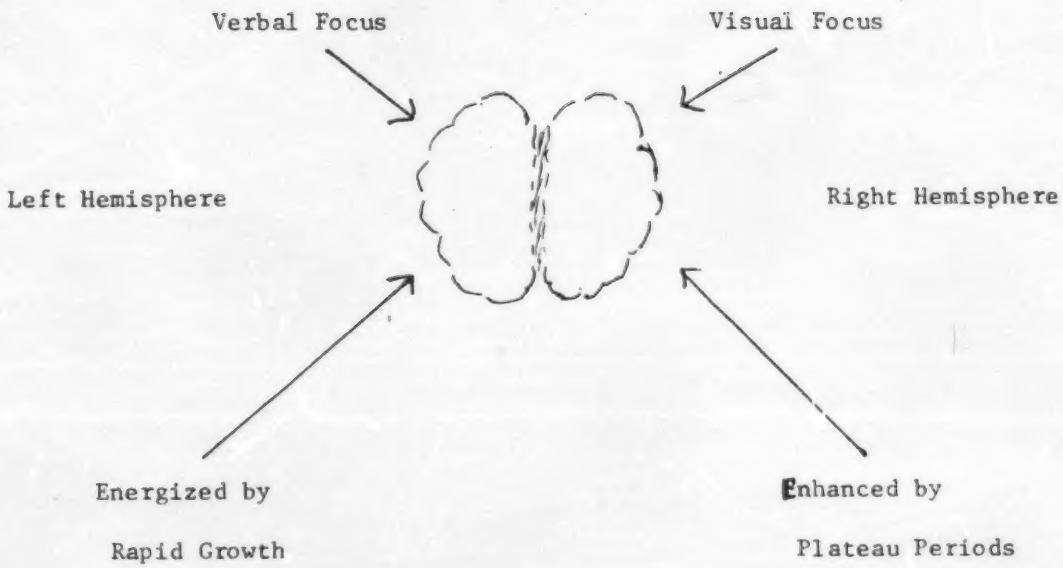
Figure 1



A summary configuration of the areas of responsibility of the two hemispheres of the brain